PRESSURE-ACTUATED NORMALLY OPEN FLUID VALVE

Field of the invention

This invention relates to fluid valves, and more particularly to a modification of a standard normally closed solenoid valve that allows it to function as a normally open valve controlled by fluid pressure rather than electricity.

Related cases

This application claims the benefit of U.S. Provisional Application No. _____, filed 14 May 2004 and entitled CONVERTED SOLENOID VALVES FROM NORMALLY CLOSED TO NORMALLY OPEN AND FROM ELECTRICALLY OPERATED TO NON-ELECTRICALLY OPERATED (Docket: ValvePat-251) and U.S. Provisional Application No. _____, filed 14 May 2004 and entitled METHOD AND APPARATUS FOR SELF CLEANING BACK FLUSH FILTER (Docket: Flush Pat-210), both of which name Robert S. Bosko as the sole inventor and the entire contents of both are incorporated herein by reference.

Background of the invention

There are numerous industrial and commercial applications where it is desirable to control a flowing fluid with an inexpensive normally open non-electric valve, as opposed to the commonly employed normally closed solenoid type of valve. For example, small water purification systems using reverse osmosis membranes are useful in localities where the water quality is poor and conventional solenoid valve mechanisms tend to become clogged with mineral deposits. It is precisely in those locations, however, that electrical power supplies tend to be spotty and expensive, so that reliance on electrical power is prone to shut off the water even though the water mains are still under pressure. In such localities, cost also tends to be a major factor in equipment selection and operation, a consideration that is exacerbated by the fact that holding a common

solenoid valve open uses electricity continuously, and the fact that specially designed non-electrical normally open valves are expensive.

Another situation in which inexpensive non-electric normally open valves are useful is one in which flammable or explosive liquids need to be conveyed in small, low-cost installations with little supervision and maintenance.

Summary of the invention

In accordance with the invention, a standard inexpensive normally-closed solenoid valve is converted to a non-electric normally-open valve operated by air pressure or other pressure media, by substituting for the solenoid coil and plunger a flexible, fluid-tight diaphragm which is normally pushed away from the valve seat by the conveyed fluid pressing against the inner surface of the diaphragm. When it is desired to stop the fluid flow, compressed air or another suitable pressure medium is applied to the outer surface of the diaphragm so as to push it against the valve seat and shut off the flow.

Brief description of the drawings

Fig. 1 is a schematic diagram illustrating one use of the invention;

Fig. 2 is a schematic axial cross section showing a conventional solenoid valve in its normally closed position;

Fig. 3 is a schematic axial cross section of the same valve in its powered open position;

Fig. 4 is a schematic axial cross section of the valve of Fig. 2, as modified in accordance with the invention, in its normal open position; and

Fig. 5 is a cross section like Fig. 4 but showing the valve in its pressurized closed position.

Description of the preferred embodiment

Fig. 1 schematically shows a small water purification system 10 in which the valve 12 of this invention is useful. The system 10 includes a feed water source 14 (which may be pre-filtered), a small manual or automatic control valve 16, a main valve 12 constructed in accordance with this invention, a source 18 of compressed air or other pressure medium, and a pressure boost pump 20 whose output is applied to a reverse osmosis membrane 22. The output of the membrane 22 is the purified water supply 24, and the residual concentrate is discharged to drain 26.

In accordance with the invention, the main valve 12 is a modified version, as described hereafter, of a conventional inexpensive solenoid valve commonly available in hardware stores for use in domestic sprinkler systems. Although the specific structure of these valves varies from manufacturer to manufacturer, in their simplest form they all work in essentially the same way. As best seen in Figs. 2 and 3, they have a body 28 with an inlet 30 and an outlet 32. Water flows from the inlet 30 to the outlet 32 through an apertured valve seat 34. A plunger 36 is biased against the valve seat 34 by a spring 37 (Fig. 2) but can be pulled up into the central cavity of the housing 38 and away from the valve seat 34 by the solenoid coil 40 (Fig. 3) when the coil 40 is energized.

The valve 12 in the system of Fig. 1 is modified as shown in Figs. 3 and 4. The plunger 36, spring 37 and solenoid coil 40 have been removed, and the lower end of the housing 38 has been closed off by a flexible diaphragm 42. An external pressure line 44 has been connected to the top of the housing 38, and a passage has been formed in the top of housing 38 to let the pressure line 44 communicate with the interior of housing 38.

As seen in Fig. 3, as long as there is no pressure in the pressure line 44 (control valve 16 set to connect line 44 to atmosphere through vent 46), the diaphragm 42 is pushed away from the valve seat 34 by the pressure of the water flowing through the valve 12, and the valve 12 remains open. When the control valve 16 is now turned to interconnect the line 44 with the compressed air tank 18, the resulting air pressure in line 44 forces the diaphragm 42 against valve seat 34 and shuts off the water flow through the main valve 12.

It will be noted that if the air path is properly sealed and the valve 16 is turned to a position preventing any escape of air from line 44, the pressurization of line 44 can be maintained indefinitely without any need for additional compressed air, thus making the operation of the inventive system very economical. It will also be noted that since the flexible diaphragm 42 (which may be made of rubber or other similar suitable material) is the only moving part in valve 12, hazardous friction between metal parts is avoided when flammable or explosive fluids are being conveyed.

Although the invention has been described in connection with a specific embodiment, it will be understood that the inventive concept is not limited thereby but may be carried out in a variety of forms limited only by the appended claims.